

1. Introduction to Sound

Objectives

- Identify how **sound travels in air**
- Discuss waves in terms of **amplitude and frequency**
- Consider the effects of **phase** and the impact of this on recording

Skills Development

- Numeracy (waves / phase / sine)

Key Words

Volume
Amplitude
Frequency
Wavelength
Hertz
Cycle
Oscillation
Phase
Constructive Interference
Destructive Interference
Harmonics
Decibel
XLR

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What is Sound?

- Sound moves in air through a **vibration causing a disturbance in air particles.**
- This causes them to **move towards** each other and **eventually transfer the vibration to our eardrum.**
- A sound wave tells us **lots of information** about the sound itself.

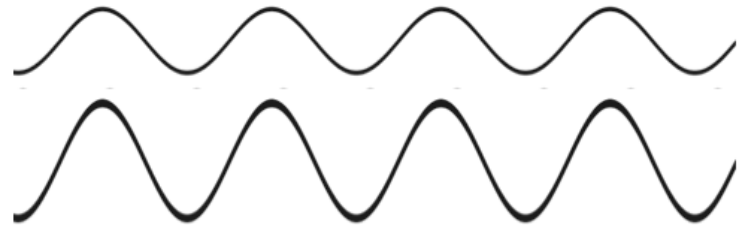
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Frequency and Amplitude

- We can think of a sound wave in two main ways; its **amplitude** and its **frequency**.



The bottom wave has a higher frequency



The bottom wave has a louder amplitude

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Frequency and Amplitude

- An increase in **amplitude** gives a louder **volume**.
- An increase in **frequency** gives a higher **pitch**.
- Dynamic range processors change the **volume / amplitude** of the sound.
- **Filters** and **equalisers** change the volume of (add or remove) **frequencies** in a sound.

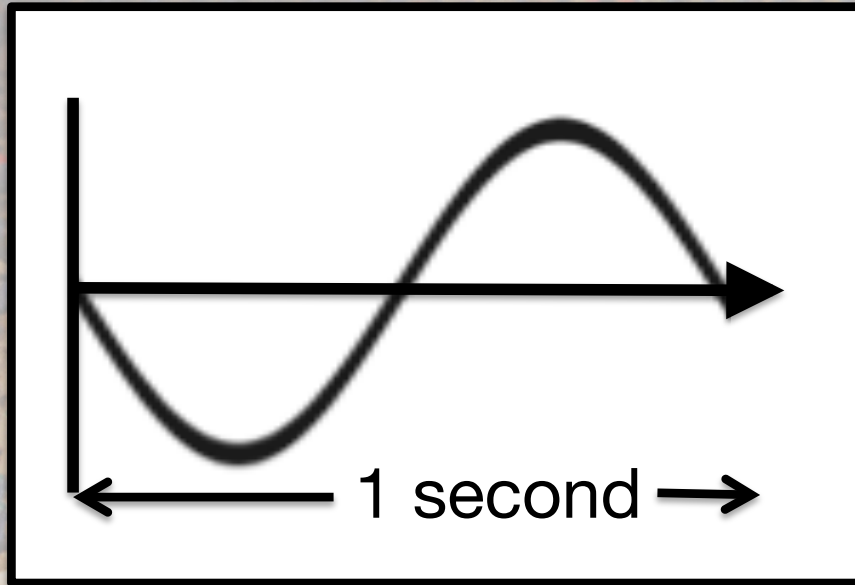
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Wave Cycles

- A wave cycle is a 'complete wave' that moves from **0**, through its **maximum and minimum**, then back to **0** again.
- **Hertz** is a measurement of **frequency**.
- If a wave completed **one cycle** in **one second**, we would say that it had a frequency of **1Hz**.

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Wave Cycles



This wave has a frequency of 1Hz.

There has been one cycle or oscillation in one second

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Wave Cycles

- Humans can hear between **20Hz and 20,000Hz**. We can simplify this by remembering **20Hz to 20kHz**.
- Higher-frequency hearing tends to **deteriorate as we get older**.
- Amplitude is **measured in decibels**. This is written as **dB**.

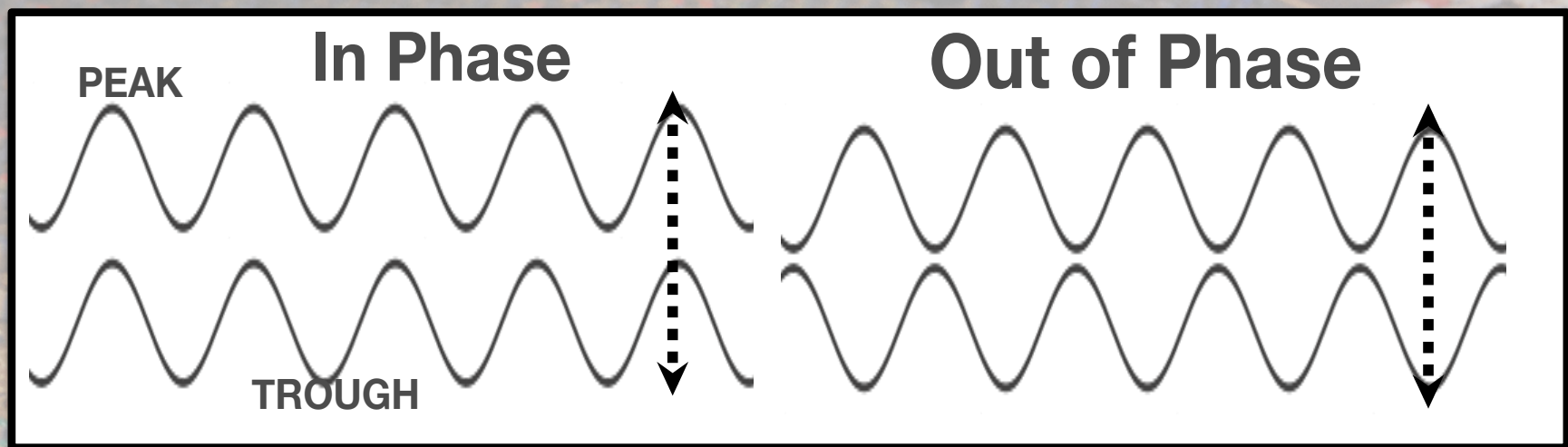
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Phase

- If sound waves are **in phase**, then their **peaks & troughs** line up
- If sound waves are **out of phase** then the peaks & troughs do not line up and cause destructive interference,
- This can sometimes **completely cancel out** the sound of the wave.

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Phase

- Phase must be considered when recording with **two close microphones** or **from either side of a drum**.
- Many mixers and DAWs have **phase invert buttons**. These swap the phase of the signal to solve this problem.



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Harmonics

- Harmonics are **mathematically and musically** related waveforms.
- They occur naturally when a note is played as an **oscillation** on a string or tube. When this occurs, you hear **one main note**, but also a number of **other, quieter frequencies**.
- Rather than hearing these as notes, they often **form part of the sound's timbre**

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Harmonics

- It is possible to **isolate higher harmonics** on stringed and wind instruments. This changes the timbre of the note, often sounding 'thinner' or 'cleaner'.
- Harmonic waveforms **fit exactly onto themselves**.

